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CLINICAL STUDIES

Cardiac Surgery in the Octogenarian: Perioperative Outcome and Clinical Follow-Up

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The perioperative and follow-up results of cardiac operations employing extracorporeal circulation and cold cardioplegic arrest were examined in 191 consecutive patients ≥80 years of age having surgery over a 5 year period (1982 to 1986). Most patients had severe preoperative symptoms with functional class III (39.8%) or IV (57.1%) limitation.

The overall 30 day postoperative cardiac mortality rate was 15.7%. The total in-hospital mortality rate was 18.8%; the mean postoperative hospital stay was 16.4 ± 13.3 days. The perioperative mortality rate for elective operations was as follows: coronary artery bypass (5.6%), aortic valve replacement (9.6%), aortic valve replacement with coronary bypass (17.9%) and mitral valve surgery with or without coronary bypass (21.4%). Urgent operations were performed in 39 patients (20.4%) with a total perioperative mortality rate of 35.9%; urgent coronary artery bypass was performed in 26 patients (67%) with an in-hospital mortality rate of 23.1%. Clinical evidence of left ventricular failure, functional class IV symptoms, left ventricular ejection fraction <50%, mitral valve repair or replacement for severe mitral regurgitation and urgent operation were associated with an increased perioperative mortality rate.

Follow-up study in all 155 patients surviving postoperative hospitalization at 22.6 ± 14.8 months showed significant improvement in symptom status in all surgical subgroups. There were 18 follow-up deaths (11.6%); 10 were noncardiac. The actuarial survival rate of the entire study group was significantly better than that in age- and gender-matched control subjects (p = 0.037).

Elective cardiac surgery can be performed in selected octogenarians without a prohibitive mortality rate and with significant lessening of symptoms and possibly, overall improvement in longevity of patients surviving postoperative hospitalization.

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Physicians and surgeons now encounter increasing numbers of highly symptomatic elderly patients with serious cardiac disease that warrants consideration of cardiac surgery. Advanced patient age, however, may often make attending physicians reluctant to pursue the necessary operative intervention (1,2).

Controversy exists as to whether the considerable proportion of health care resources expended on the growing minority of very elderly patients represents a cost-effective approach in an attempt to maintain life of a meaningful quality (3–5). Therefore, it is important to examine late postoperative survival and functional outcome in addition to early morbidity and mortality after cardiac surgery in this group of patients.

In this study, we examine the early and late results of cardiac surgery in the very elderly (age ≥80 years) to further define the potential risks versus benefits of such intervention.

Methods

Study patients. A total of 195 patients ≥80 years of age underwent cardiac surgery at the Mayo Clinic between January 1, 1982 and December 31, 1986. Retrospective review of the patients' clinical records was performed in each case. Standard hypothermic extracorporeal circulation and cold cardioplegic arrest were employed in 191 patients; 4 patients underwent uncomplicated pericardiectomy without cardiopulmonary bypass and were excluded from further analysis in this study.

The mean age at the time of operation was 82.3 ± 2.4 years (range 80 to 91). A slight majority (53.9%) of patients were male. Nearly all patients were severely symptomatic with either New York Heart Association functional class IV (57.1%) or class III (39.8%) limitation before operation. Clinical congestive heart failure was present in 39.3% of all patients before operation.

Of the entire study group, 98 patients (51.3%) had a clinical history of chronic coronary artery disease and 42 patients (22%) had a remote prior myocardial infarction. Forty-two patients (22%) presented with unstable angina

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pectoris and 28 patients (14.7%) had an acute myocardial infarction within 7 days of cardiac surgery.

Coronary angiography. This was performed in 179 patients (93.7%) before operation. Significant (≥70% luminal stenosis) coronary artery disease was found in 75.4% of all patients undergoing angiography (single-vessel disease in 15.5%, double-vessel disease in 26.7% and triple-vessel disease in 57.8%); 32 patients (17.9%) had left main coronary stenosis ≥50%. Left ventricular ejection fraction was determined by biplane left ventricular angiography in most cases and by radionuclide angiography or two-dimensional echocardiography if left ventriculography was not performed.

Surgical procedures (Table 1). Of 120 patients undergoing coronary artery bypass surgery, 27.4% had an internal mammary artery graft. Of 96 patients having aortic valve replacement with or without coronary bypass surgery, 91 (94.8%) had severe aortic stenosis (mean aortic valve area 0.56 ± 0.28 cm^2); the remaining 5 patients had severe aortic regurgitation. Mitral valve repair or replacement was performed for mitral regurgitation in 29 patients and for combined mitral stenosis and regurgitation in 10 patients; 12 patients underwent mitral valve surgery as part of a double or triple valve operation.

Follow-up. Clinical follow-up was complete (100%) in patients surviving postoperative hospitalization. When a patient was unable to return to the Mayo Clinic for postoperative reevaluation, follow-up contact was made with the patient or local physician, or both, by letter or telephone. New York Heart Association functional limitation was reassessed in those patients alive at follow-up evaluation.

Statistical analysis. All 191 patients undergoing cardiopulmonary bypass were analyzed as a whole; subgroup analysis was performed on the patients having coronary artery bypass surgery (n = 62), aortic valve replacement (n = 45), coronary artery bypass surgery with aortic valve replacement (n = 42) and mitral valve repair or replacement with or without coronary artery bypass surgery (n = 27). Limited patient numbers precluded further subgroup analysis of other categories such as double valve procedures with or without coronary artery bypass.

Early mortality included all in-hospital deaths. Individual variables were assessed by the chi-square test for nominal data and by Wilcoxon rank sum and Student's *t* test for ordinal and continuous data. Too few in-hospital deaths were observed to develop a reliable multivariate analysis for early survival.

Patients who died in the hospital were excluded from long-term survival analysis. The log-rank test was employed to assess association of nominal variables with long-term survival in a univariate fashion. The logit rank test or Cox regression model was used to examine ordinal and continuous variables in long-term survival; again, there were too few long-term deaths to develop a multivariate model for late survival. Kaplan-Meier actuarial probability of survival was performed and compared with that in age- and gender-matched control subjects from the 1980 Minnesota Life Table utilizing a one-sample version of the log-rank test.

Table 1. Surgical Procedures Performed in 191 Patients

	No. of Patients (%)
Coronary artery bypass	62 (32.5)
Aortic valve replacement	45 (23.6)
Aortic valve replacement + coronary artery bypass	42 (22.0)
Mitral valve repair or replacement + coronary artery bypass	14. (7.3)
Mitral valve repair or replacement	13 (6.8)
Double valve procedure	9 (4.7)
Triple valve procedure	2 (1.1)
Double valve procedure + coronary artery bypass	1 (0.5)
Left ventricular aneurysmectomy + coronary artery bypass	1 (0.5)
Sinus venosus atrial septal defect repair	1 (0.5)
Postinfarct ventricular septal rupture repair	1 (0.5)

Individual preoperative variables examined were age (80 to 85 vs. >85 years), gender, type of valvular heart disease if present, history of acute or remote myocardial infarction, nature of cardiac symptoms (angina, syncope, dyspnea), New York Heart Association functional class, cardiac rhythm (normal sinus vs. atrial fibrillation), presence of conduction system disease, cardiac size and pulmonary congestion on chest X-ray film, number of diseased coronary arteries (≥70% luminal stenosis), presence of left main coronary disease (≥50% luminal stenosis), left ventricular ejection fraction and urgency of operation. The urgency of operation was defined by the clinical setting and was classified as elective or urgent (performed within 24 h of presentation or diagnostic evaluation).

Associated medical diseases, such as peripheral vascular disease, cerebrovascular disease, hypertension, diabetes mellitus and pulmonary and renal disease, were frequently present in this group of patients. However, the clinical severity of associated conditions was extremely variable, with a broad spectrum of prior delineation and treatment. Hence, independent examination of these factors was not systematically done in this study.

Data are expressed as mean values ± SD. Differences were considered statistically significant at $p < 0.05$.

Results

Surgical procedures (Table 1). Coronary artery bypass surgery, isolated aortic valve replacement or combined aortic valve replacement with coronary artery bypass surgery accounted for 78% of all procedures. Prior cardiac surgery had been performed in only seven patients (3.7%): aortic valve replacement in four and coronary artery bypass surgery in three. Elective procedures were performed in 152 patients (79.6%), whereas 39 patients (20.4%) underwent

Table 2. Cause of In-Hospital Death in 191 Patients

	No. of Patients (%)
Left ventricular pump failure	15 (42)
Primary arrhythmic event	9 (25)
Respiratory failure	6 (17)
Cerebrovascular accident	3 (8)
Sepsis	1 (3)
Traumatic aortotomy and hemorrhage during repeat AVR	1 (3)
Right ventricular free wall rupture and hemorrhage after AVR	1 (3)
Total	36

AVR = aortic valve replacement.

urgent operations, most frequently for coronary artery bypass.

Early perioperative outcome (Tables 2 and 3). The total 30 day postoperative mortality was 15.7% (30 patients). There were four intraoperative deaths (three due to left ventricular failure after extracorporeal circulation and one as a result of hemorrhage during attempted repeat aortic valve replacement). The mean postoperative hospital stay was 16.4 ± 13.3 days (range 6 to 98). Altogether, 36 of the 191 patients died in the hospital.

The causes of in-hospital death are listed in Table 2. The majority of deaths were due to left ventricular failure (42%) or a primary arrhythmia (25%) leading to cardiac arrest. A noncardiovascular cause accounted for 28% of all in-hospital deaths.

The in-hospital mortality rate for the various surgical subgroups is presented in Table 3. The overall mortality rate for elective operations was 14.5%, with coronary artery bypass surgery having the lowest mortality rate (5.6%) and mitral valve surgery with or without coronary artery bypass surgery having the highest mortality rate (28.6%). Patients undergoing urgent cardiac operation had a nearly 2.5 times greater hospital mortality rate (35.9%). The mortality rate for urgent coronary artery bypass surgery was fourfold greater (23.1%) than in patients operated on electively. The remaining subgroups of urgent operations had too few patients to derive meaningful mortality data. Twelve of the 15 patients with miscellaneous surgical procedures (cumulative mortality rate 26.7%) had a mitral valve operation as part of a multiple valve operation with or without coronary artery bypass surgery.

Table 3. Hospital Mortality in 191 Patients*

Procedure	Elective Operation	Emergency Operation	Total
CAB	2/36 (5.6)	6/26 (23.1)	8/62 (12.9)
AVR	4/42 (9.5)	1/3 (33.3)	5/45 (11.1)
AVR + CAB	7/39 (17.9)	2/3 (66.7)	9/42 (21.4)
MVR ± CAB	6/21 (28.6)	4/6 (66.7)	10/27 (37.0)
Misc	3/14 (21.4)	1/1 (100)	4/15 (26.7)
Total	22/152 (14.5)	14/39 (35.9)	36/191 (18.8)

*Deaths/patients operated on (% mortality). AVR = aortic valve replacement; CAB = coronary artery bypass; Misc = miscellaneous; MVR = mitral valve repair or replacement.

Table 4. Major In-Hospital Perioperative Complications in 191 Patients

	No. of Patients (%)
Bleeding requiring reoperation	24 (12.6)
Multisystem organ failure	20 (10.5)
Cerebrovascular accident	
Fatal	3 (1.6)
Nonfatal persistent deficit	5 (2.6)
Improved or resolved deficit	8 (4.2)
Renal failure	12 (6.3)
Perioperative myocardial infarction	9 (4.7)

Considering elective and urgent operations combined for each subgroup, the in-hospital mortality rate was lowest for aortic valve replacement (11.1%) and coronary artery bypass surgery (12.9%), intermediate for combined aortic valve replacement and coronary artery bypass surgery (21.4%) and highest for mitral valve surgery with or without coronary artery bypass surgery (37%).

Perioperative complications (Table 4). Fifty-eight patients (30.4%) had one or more in-hospital perioperative complications including bleeding requiring reoperation in 24 patients (12.6%), multisystem organ failure (all with respiratory failure) in 20 patients (10.5%), cerebrovascular accident in 16 patients (8.4%), renal failure in 12 patients (6.3%) and perioperative myocardial infarction in 9 patients (4.7%). Of the 16 patients with a cerebrovascular accident, 3 died postoperatively; 8 of the remaining 13 patients had significant improvement or resolution of their neurologic deficit by the time of hospital discharge. There was no significant difference in the incidence of perioperative cerebrovascular accident in patients having atrial fibrillation (10%) versus normal sinus rhythm (8%). Of the nine patients with perioperative myocardial infarction, three died (two of ventricular fibrillation, the third of progressive left ventricular failure). Fifteen deaths (41.6%) were directly related to a noncardiac complication.

Preoperative and operative predictors of early hospital mortality (Table 5). Evidence of significant left ventricular dysfunction by clinical or radiographic variables was clearly associated with early patient mortality. An abnormal left ventricular ejection fraction (<50%) was also predictive of early mortality; however, the mortality rate (31.8%) in patients with an ejection fraction <30% was similar to that (28.8%) in patients with an ejection fraction of 30% to 49%. The presence of severe mitral regurgitation preoperatively and to a lesser extent bundle branch block on the electrocardiogram (ECG) were also associated with significantly increased perioperative risk.

Urgent surgery and mitral valve surgery were operative variables having a significant impact on early patient sur-

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Table 5. Factors Associated With Early Hospital Mortality in 191 Patients

	Relative Risk	95% CI	p Value
Preoperative variables			
Pulmonary edema on chest X-ray film	3.6	2.1–6.4	<0.001
NYHA functional class IV limitation	3.6	1.6–8.3	<0.001
Clinical congestive heart failure	3.1	1.7–5.8	<0.001
Severe mitral regurgitation	2.7	1.6–4.8	<0.001
LVEF <50%	2.5	1.4–4.5	<0.001
Moderate to severe cardiomegaly on chest X-ray film	2.4	1.4–4.2	0.002
Bundle branch block on ECG	2.0	1.1–3.7	0.019
Operative variables			
Urgent surgery	2.5	1.4–4.4	0.002
Mitral valve surgery	2.2	1.2–4.0	0.014

CI = confidence interval; ECG = electrocardiogram; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association.

vival. Other factors of borderline statistical significance were left main coronary artery stenosis ≥50% (p = 0.052) and age >85 years (p = 0.060).

Follow-up evaluation and long-term survival (Tables 6 and 7). Clinical follow-up (mean 22.6 ± 14.8 months; median 19.2) was available in all 155 patients who survived hospitalization. There were 18 deaths (11.6%) during the follow-up period; 10 were of noncardiac origin (five patients died of stroke, four of cancer, one of respiratory disease), 6 were of cardiac origin and 2 were of an unknown cause. The clinical functional status of patients in each of the four largest surgical subgroups was significantly improved at follow-up evaluation (Table 6).

The variables present at the time of operation associated with mortality at follow-up evaluation are listed in Table 7. Those patients presenting without an acute ischemic syndrome (that is, unstable angina or myocardial infarction) undergoing elective operation and without atrial fibrillation had a better long-term survival rate. The incidence of cerebrovascular accident during the follow-up period was significantly higher in patients with atrial fibrillation (12%) than in those with normal sinus rhythm (1.6%) but was not significantly higher in patients having prosthetic valve surgery (3.1%) than in those undergoing coronary bypass surgery only (3.7%). Adverse predictors of borderline significance were preoperative pulmonary edema (p = 0.058), age >85 years (p = 0.060) and male gender (p = 0.066).

Table 6. Follow-Up Clinical Status in 144 Patients

Surgical Subgroup	No.	NYHA Functional Class		p Value
		Preoperative	Follow-Up	
CAB	54	3.6 ± 0.5	1.6 ± 0.7	<0.0001
AVR	40	3.2 ± 0.7	1.4 ± 0.7	<0.0001
AVR + CAB	33	3.4 ± 0.6	1.9 ± 0.9	<0.0001
MVR ± CAB	17	3.6 ± 0.5	1.8 ± 0.7	<0.0001

Abbreviations as in Tables 3 and 5.

Table 7. Preoperative Factors Associated With Mortality at Follow-Up Study

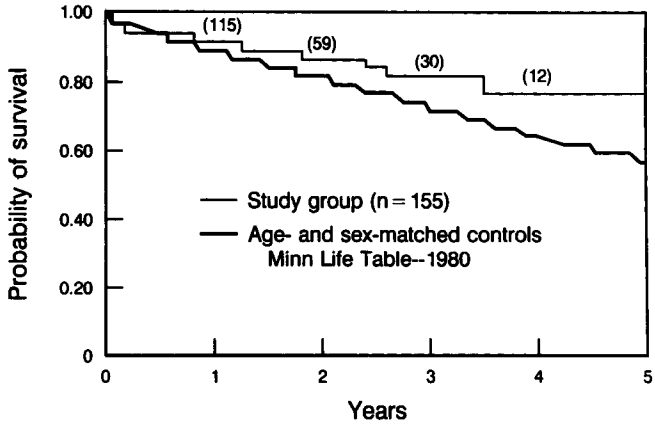
	p Value
Unstable angina pectoris	0.008
Acute myocardial infarction	0.036
Urgent operation	0.038
Atrial fibrillation	0.042

In contrast to early hospital mortality, an abnormal left ventricular ejection fraction was not predictive of mortality at follow-up study in patients surviving postoperative hospitalization. The 1-, 2- and 3-year probability of survival of the 103 patients with an ejection fraction ≥50% was 95%, 92% and 84%, respectively. This was not significantly different from that in the 52 patients with an ejection fraction <50% (including 15 patients with an ejection fraction <30%). In this subgroup, the probability of survival was 92%, 84% and 84% at 1, 2 and 3 years, respectively.

The probability of survival for all patients surviving postoperative hospitalization is shown in Figure 1. The freedom from both cardiac and noncardiac death was 92% at 1 year, 87% at 2 years, 82% at 3 years and 78% at 4 years compared with the predicted survival rates of 89%, 83%, 73% and 66%, respectively, in age- and gender-matched control subjects. This difference in survival was statistically significant (p = 0.037).

The probability of survival of patients discharged from hospital was analyzed separately for the main surgical subgroups: coronary artery bypass (Fig. 2A), aortic valve replacement (Fig. 2B), aortic valve replacement with coronary artery bypass (Fig. 2C) and mitral valve surgery with or without coronary artery bypass (Fig. 2D). In each subgroup,

Figure 1. Actuarial probability of survival in 155 patients ≥80 years of age discharged from the hospital after cardiac surgery with cardiopulmonary bypass. Long-term survival was significantly better than that in age- and gender-matched control subjects (p = 0.037). Minn = Minnesota.



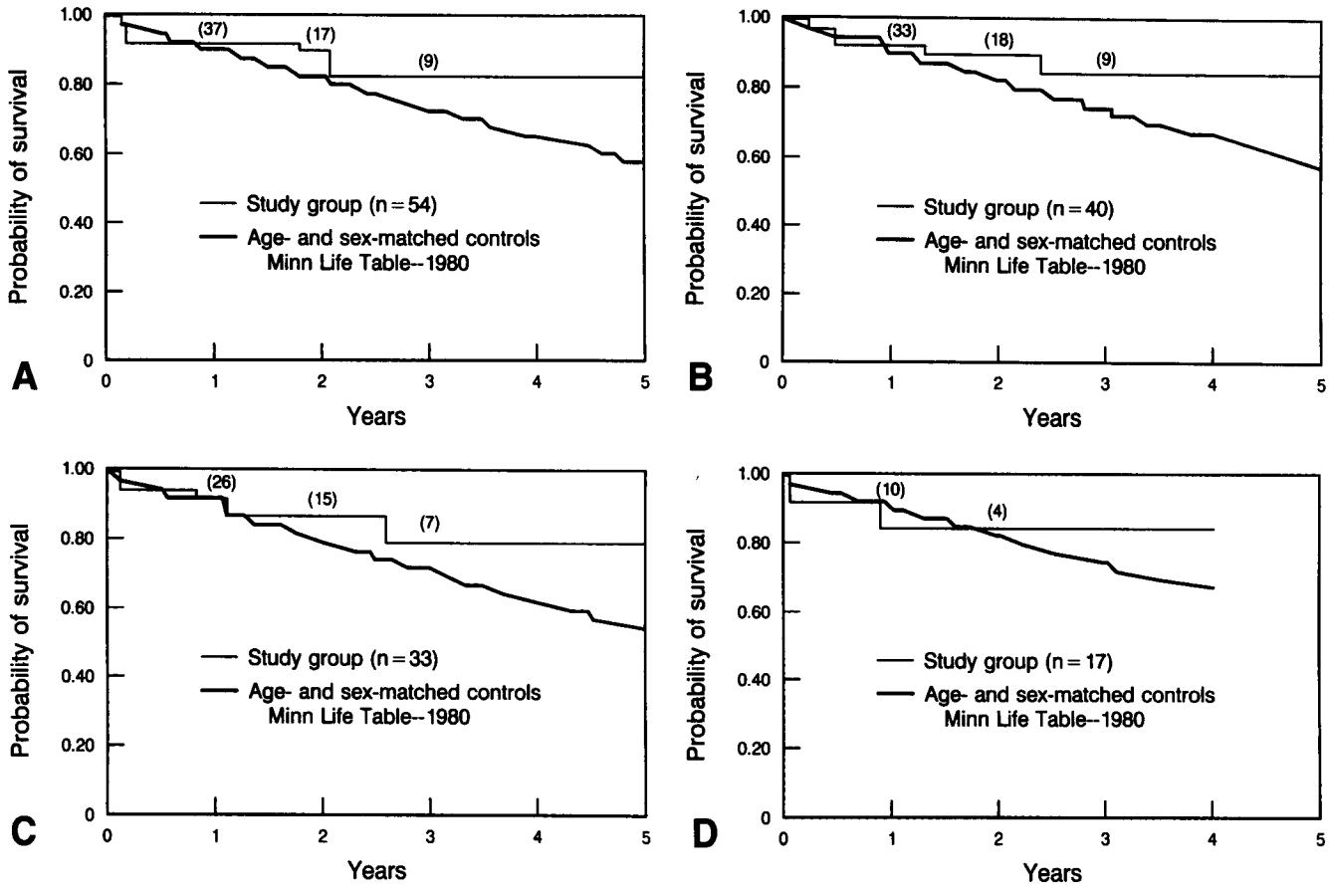


Figure 2. Actuarial survival of patients ≥80 years of age after cardiac surgery classified according to procedure and compared with age- and gender-matched control subjects. No significant difference in survival was detected in any individual subgroup. **A**, Coronary artery bypass surgery ($p = 0.099$). **B**, Aortic valve replacement ($p = 0.118$). **C**, Aortic valve replacement with coronary artery bypass surgery ($p = 0.217$). **D**, Mitral valve surgery with or without coronary artery bypass surgery ($p = 0.393$). Minn = Minnesota.

the survival of the study patients compared favorably with age- and gender-matched control subjects.

The survival rates for the postoperative period and subsequent long-term follow-up period were derived separately so that relevant conclusions can be drawn with respect to each study period. The overall probability of surviving both the postoperative period to a given time after hospital discharge can be calculated by multiplying the long-term probability of survival at that time by the probability of hospital survival: 1 − (% hospital mortality/100).

Discussion

It has been previously well documented that the perioperative mortality rate escalates with increasing age for patients undergoing coronary artery bypass surgery (6–10), aortic valve replacement (11–15) or mitral valve replacement (14–16) with or without concomitant coronary artery bypass surgery. The number of patients ≥80 years of age undergoing cardiac surgery appears to be increasing yearly (17,18).

Clinical presentation. As has been generally observed in prior reports of cardiac surgery in octogenarian patients (17,19–22), most patients in this age group (97% in the current series) present with New York Heart Association functional class III or IV symptoms that are generally refractory to more conservative management. A significant minority of patients present with unstable or life-threatening symptoms that further compel operative intervention. The urgency of presentation forces the issue of cardiac surgery in an otherwise "viable" octogenarian and has a significant impact on the operative mortality rate.

In our study, the overall perioperative mortality rate was 2.5 times greater in patients having urgent versus elective surgical procedures. In most cases, urgent surgery was performed for unstable ischemic syndromes, and the resultant early mortality rate (23.1%) was four times that associated with elective coronary bypass surgery. A lesser but clearly increased mortality rate (8.5% to 13.7%) has been noted for emergency versus elective coronary artery bypass surgery in series of younger patients (6–8,23,24). Emergency cardiac surgery in octogenarians has also been shown to be independently predictive of an increased perioperative mortality rate (17).

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Preoperative clinical predictors of operative mortality. Additionally, we found that several clinical variables indicative of left ventricular failure, left ventricular ejection fraction <50%, functional class IV symptoms, presence of severe mitral regurgitation and bundle branch block on the ECG were preoperative variables associated with perioperative mortality. Preoperative left ventricular dysfunction and clinical congestive heart failure were shown to be powerful predictors of operative mortality in generally younger patients undergoing coronary artery bypass (6–8) and valvular surgery (14,16). Similarly, class IV functional limitation is recognized to increase the perioperative mortality rate (14,16,17). In contrast to others (6,7), we found that patient gender in our octogenarian patients did not influence early postoperative survival. Left main coronary artery disease was relatively common (18%) in this study group; however, it was less frequently associated with operative mortality than in larger series of younger patients undergoing coronary artery bypass surgery (6,7).

Impact of elective operative procedure. For elective operations, the type of cardiac surgical procedure clearly influenced perioperative mortality. The early mortality rate was lowest (5.6%) with elective coronary artery bypass surgery in this group of octogenarians, comparing favorably with rates of 3.6% to 9.5% in larger series of patients ≥75 years of age (7,10,24).

Aortic valve replacement had an intermediate early mortality rate (9.5%) that increased with concomitant coronary artery bypass surgery (17.9%), but was not a univariate predictor of operative mortality in our series. Similar results have been previously observed in octogenarians (18,20,22).

The perioperative mortality rate was clearly highest in patients undergoing mitral valve surgery with or without coronary artery bypass surgery (28.6%). Of all procedures, only mitral valve surgery (and severe mitral regurgitation before operation) was significantly associated with an increased perioperative mortality rate. Mitral valve surgery has been previously identified as an independent risk factor for operative mortality in elderly patients (14), and in patients ≥70 years of age, the perioperative mortality rate has ranged from 16% (14) to 50% (25). Because of the small patient number, it was not possible to ascertain the influence of the etiology of mitral regurgitation (for example, ischemic, rheumatic or degenerative) or operative procedure (mitral valve repair vs. replacement) on the mortality rate in this surgical subgroup.

Follow-up evaluation and long-term survival. Nearly all patients in this series had significant preoperative symptomatic limitation. In each of the four largest surgical subgroups, there was significant improvement in mean functional class at follow-up evaluation. Of the 18 deaths during the follow-up period, the majority were of noncardiac origin. Similar improvement in symptomatic status with a low (0% to 8%) occurrence of late cardiac death has been observed by other investigators (17,18,20,22).

Preoperative univariate variables predictive of the long-term mortality rate were unstable angina, acute myocardial infarction, urgent operation and atrial fibrillation. As with another study (18) of octogenarians' status after aortic valve surgery, limited patient numbers and low incidence of death during the follow-up period precluded identification of independent predictors of late mortality by Cox proportional hazards analysis.

Unlike perioperative mortality, late mortality did not appear to be significantly associated with preoperative left ventricular dysfunction or clinical congestive heart failure. Such variables have been shown to be independent predictors of long-term survival in "younger" elderly patients analyzed in the Coronary Artery Surgery Study (CASS) (26), but not in octogenarians (17,18). Because patients with significant left ventricular dysfunction had a clearly higher perioperative mortality rate in our study, it is possible that these patients at increased risk were selected out because of death before hospital discharge. Nearly 50% of the patients in this study underwent aortic valve replacement for aortic stenosis; this procedure may have lessened the potential impact of poor preoperative left ventricular function in this subgroup of patients.

Postoperative atrial fibrillation has been shown to be an independent variable influencing long-term survival after coronary bypass surgery in a larger series of patients ≥65 years of age (10). More than 25% of late deaths in our series were secondary to cerebrovascular accident, with the incidence of cerebrovascular accident being more than six times greater in patients with atrial fibrillation than in those with sinus rhythm.

The actuarial survival rate of all patients in the current study discharged from the hospital after cardiac surgery was significantly better than that of age- and gender-matched control octogenarians. Although a relatively small surgical subgroup, the 54 patients who underwent coronary bypass surgery had a survival rate of 83%, which compares favorably with the 3 year survival rate of 90% in a much larger series of younger patients (26). The 3 year survival rate of 80% to 85% observed in the 77 patients having aortic valve replacement with or without coronary bypass surgery is very similar to that observed by Levinson et al. (18). Although the survival rate in patients undergoing mitral valve procedures was not significantly different from that in control subjects, the number of patients in this subgroup was quite small.

Limitations. This study group clearly was a preselected nonrandomized series of octogenarians with a broad spectrum of cardiac and noncardiac disease of variable severity. Clinical discernment between the physiologically "young" and "old" octogenarian can be difficult because the effects of aging on the cardiovascular system and the functional reserve of other organ systems may vary widely in individual patients (5,27). As in everyday clinical practice, selection bias for operative intervention in this age group is inescapable and influenced by a multifaceted subjective judgment on the part of the attending physician and consulting surgeon. It is possible that "healthier" octogenarians were selected for

surgery and hence, the patients surviving postoperative hospitalization as a whole had better actuarial probability of survival than age- and gender-matched control subjects. The effect of such selection bias may be offset in part by the significant proportion (20%) of patients in this series presenting with decompensating cardiac disease forcing high risk urgent surgery and by the generally severely symptomatic nature of the study group as a whole. The results of cardiac surgery in the octogenarian will be variable for any given institution and dependent on the aggressiveness and expertise of the surgeons as well as the nature of the referral patient cohort.

The confounding effect of associated medical diseases has been shown to affect perioperative (7) and follow-up (10,26) mortality rates in "younger" elderly patients undergoing coronary artery bypass surgery. However, other investigators (17,18) have not found concomitant noncardiac disease to be predictive of outcome of cardiac surgery in the octogenarian. Associated medical disease with symptoms and effects that ranged from none to debilitating was very common in the current series of patients. It was not possible to assess the potential influence of widely divergent noncardiac disease in this relatively small group of patients. The number of patients with severe noncardiac disease perceived to be "too sick" for cardiac surgery during the period of this study is unknown.

Conclusions and implications. Elective cardiac surgery can be performed in selected patients ≥80 years of age without prohibitive perioperative mortality or morbidity and with anticipation of significantly improved symptomatic status and probably increased longevity. Delay of indicated operative intervention in deference to advanced age may only set the stage for an urgent operation with a severalfold increased perioperative mortality rate. Early mortality is least with elective coronary artery bypass surgery and greatest in surgery for mitral regurgitation. Clinical evidence of preoperative left ventricular failure, functional class IV symptoms and urgent surgical procedures are associated with increased perioperative death.

There are many subjective and intangible issues to be considered in attempting to assess the very aged patient's quality of life with or without cardiac surgery. Undoubtedly socioeconomic concerns will have an increasing influence on this difficult decision in the future. Individualized and circumspect clinical analysis and judgment with earnest interaction with the patient and family will likely serve as the best approach in evaluating the octogenarian for cardiac surgery.

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